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Effect of Seed Treatments on Seedling Emergence, Severity of Seedling Blight, and Yield of Rice

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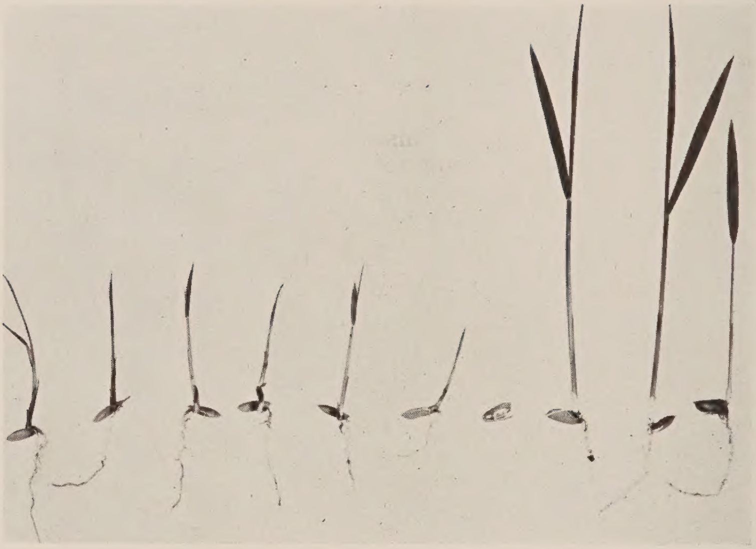

Figure 1. Blue Rose seedlings from greenhouse: 7 diseased seedlings at left; 3 healthy seedlings at right.

EFFECT OF SEED TREATMENTS ON SEEDLING EMERGENCE, SEVERITY OF SEEDLING BLIGHT, AND YIELD OF RICE

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Rice seedling blight is a disease complex encountered in most of the rice-producing countries of the world. In the United States, where the problem has received relatively little attention, severe blighting has been observed in Arkansas, Louisiana, and Texas. Brief discussions of the early investigations have been reported by the writers *(3, 4, 5, 17)*. Observations over a period of years indicate that the amount of seedling blighting depends upon weather conditions and the microflora of the rice seed and soil, and varies from year to year. A number of fields have been observed where pre-emergence blighting had reduced the stand to a point where reseeding was necessary. However, in the majority of cases, sufficient seedlings emerge, even though a large percentage of them may be diseased, to insure a fair stand. Diseased seedlings that emerge usually survive, in a weakened state, until submergence, when the disease symptoms gradually disappear. A comparison of healthy and diseased seedlings is shown in Figure 1.

Investigators have tried seed treatments for the control of rice seedling diseases with varying degrees of success. Nisikado and Miyake *(9)*, who worked on the Helminthosporium disease of rice in Japan, recommended the treatment of seed with hot water at 53° C. for 10 minutes, at 54° C. for 5 minutes after the seed had been previously soaked for one day in water at 10° to 15° C. Tucker *(16)*, in a preliminary report on the brown spot disease of rice in Puerto Rico, indicated that chemical disinfectants were of little value in the control of seedling blight, and stated that the best method of control would probably be the use of clean seed. Tisdale *(15)* showed that the hot water treatment was effective in killing fungi carried within the seed, but was doubtful as to the ultimate value of the treatment since he states, "Until more information is obtained regarding these fungi and their life histories it would be inadvisable to recommend seed treatments which would kill only the fungi in the seed." Ito *(6)* recommended seed treatment with formalin for the control of

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TABLE 1. FUNGI ISOLATED FROM SUPREME BLUE ROSE SEEDLINGS FROM THE FIELD AT THE RICE BRANCH EXPERIMENT STATION, 1933 TO 1936

Date of seeding	Source of seed	Total number of isolations	Fusarium spp.	Rhizoctonia sp.	Curvularia lunata	Pythium spp.	Helminthosporium oryzae	Curvularia maculans	Alternaria sp.	Penicillium sp.
			Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
April, 1933	Rice Branch Experiment Station	16	37.4	31.2	0.0	31.2	0.0	0.0	0.0	0.0
May, 1933	" "	25	56.0	40.0	0.0	0.0	4.0	0.0	0.0	0.0
April, 1934	" "	116	31.9	60.0	3.44	4.3	0.86	0.0	0.0	0.0
May, 1934	" "	55	30.9	10.87	14.4	41.8	1.8	0.0	0.0	0.0
June, 1934	" "	55	60.0	0.0	34.5	0.0	5.4	0.0	0.0	0.0
April, 1935	" "	160	29.0	52.0	2.5	11.0	2.5	1.2	0.0	0.0
May, 1935	" "	281	82.9	3.2	7.1	4.9	0.3	0.3	1.0	0.0
April, 1936	" "	451	31.0	14.0	12.0	2.0	4.0	1.0	7.0	29.0
May, 1936	" "	190	51.0	1.0	18.0	0.0	1.0	0.0	11.0	18.0
April, 1936	Beaumont, Texas[1]	554	30.0	8.0	4.0	2.0	26.0	1.0	1.0	28.0
May, 1936	" "	171	21.0	2.0	7.0	0.0	40.0	0.0	1.0	29.0

[1]Beaumont, Texas—Texas Substation No. 4.

Piricularia oryzae, Helminthosporium oryzae, and *Gibberella fujikuori.* Bugnicourt *(2)* recommended the use of formalin and mercuric chloride for seed treatments. Loh *(7)* also recommended the use of mercuric chloride for seed treatment. His method of treatment was to soak the seed for several hours under a suction pump until all of the air between the glumes was exhausted, and then treat it for 25 to 30 minutes in a one per cent mercuric chloride solution. After the treatment, the seeds were thoroughly washed under aseptic conditions in sterile water.

The studies of seedling blight of rice reported in this bulletin have been confined to (1) the relative importance of various seed and soil-borne fungi found in association with blighting; (2) the effect of soil temperatures on the severity of seedling blight; and (3) the effects of seed treatments on emergence, severity of blighting, and yield of rice.

FUNGI ASSOCIATED WITH DISCOLORED KERNELS AND SEEDLING BLIGHT

According to work previously reported by Tullis *(18)*, the following fungi, ranking in relative abundance in the order named, were found in discolored rice kernels: *Helminthosporium oryzae* Brede de Haan, *Trichoconis caudata* (Ap. and Str.) Clem., *Curvularia lunata* (Wakker) Boedijn, *Fusarium* spp., and *Phoma* spp. In order to determine if these fungi isolated from discolored kernels were associated with seedling blight, isolations were made from 2,074 diseased seedlings grown at the Rice Branch Experiment Station, 1933-1936. Small pieces of the discolored seedlings just above the kernels were removed, surface-sterilized in 1:1000 mercuric chloride for 30 to 45 seconds, washed in sterile water, and cultured in Petri dishes containing corn meal agar. *Fusarium* spp.[2], *Rhizoctonia* sp.[3], *C. lunata,* and *H. oryzae* were the fungi most consistently isolated from diseased seedlings. It seems probable that all of the important fungi associated with seedling blighting, with the exception of *Rhizoctonia* sp. may have been seed-borne. (See Table 1.)

The pathogenicity of most of the above fungi has been established. The writers were able to produce blighting of Supreme Blue Rose rice seedlings growing *in vitro* under aseptic conditions with *Fusarium* spp., *Rhizoctonia* sp., *Curvularia lunata,* and *Helminthosporium oryzae,* while *Gibberella moniliformis (10), Gibberella fujikuori (14), H. oryzae (11), R. solani (12, 13),* and *C. lunata (8, 1)* have been reported as pathogenic on rice seedlings by other writers. *C. lunata (1)* has been referred to

[2]The two most common species of Fusaria isolated from diseased rice seedlings, according to Dr. C. D. Sherbakoff, resemble very closely Gibberella moniliformis (Sh.) Wineland and Gibberella fujikuori (Saw.) Wr.

[3]Resembles very closely R. solani Kuhn.

TABLE 2. EFFECT OF SOIL TEMPERATURES ON SEEDLING BLIGHT IN SUPREME BLUE ROSE SEEDLINGS[1] GROWN IN GREENHOUSE, MARCH 10 TO 31, 1933

Temperature	Seedlings						Diseased lightly	Diseased severely	Total diseased
	Total	Healthy	Emerged		Not emerged				
			Lightly diseased	Severely diseased	Lightly diseased	Severely diseased			
Degree C.	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Per cent*	*Per cent*	*Per cent*
18	825	443	142	95	23	122	20.0	26.3	46.3
22	908	637	203	53	31	23	25.7	8.3	34.0
26	998	622	235	100	5	36	24.0	13.6	37.6
30	1010	659	228	84	0	39	22.5	14.1	36.6
34	1012	740	137	92	9	54	14.4	14.4	28.8

[1]From moderately-blighted seed grown at Rice Branch Experiment Station in 1932.

TABLE 3. FUNGI ISOLATED FROM SUPREME BLUE ROSE SEEDLINGS GROWN AT DIFFERENT SOIL TEMPERATURES IN GREENHOUSE, MARCH 10 TO 31, 1933

Temperature	Total isolations	Fungi isolated at indicated frequencies							
		Fusarium spp.		Rhizoctonia sp.		Helminthosporium oryzae		Pythium sp.	
Degree C.	*Number*	*Number*	*Per cent*	*Number*	*Per cent*	*Number*	*Per cent*	*Number*	*Per cent*
18	53	25	47.0	4	7.5	17	32.0	7	13.2
22	28	7	25.0	1	3.5	17	60.7	3	10.7
26	25	8	32.0	9	36.0	8	32.7	0	0.0
30	29	15	51.9	5	17.3	8	27.5	1	3.4
34	35	33	94.0	2	6.0	0	0.0	0	0.0
Total	170	88	51.7	21	12.3	50	30.0	11	6.4

variously as *Helminthosporium curvulum* Sacc., *Brachysporium oryzae B.* sp., and *Dactylaria.*

EFFECT OF SOIL TEMPERATURES ON SEEDLING BLIGHT

Experiments on the effect of soil temperature on the severity of seedling blight were conducted in the greenhouse to test the significance of field observations that the most serious blighting takes place during the early part of the seeding season, that is, in April, when the soil temperature is too cool for the rapid growth of the young seedlings. The desired soil temperatures were maintained by means of Wisconsin-type temperature tanks.

In the first experiment, moderately blighted Supreme Blue Rose seed[4] from the Rice Branch Experiment Station was sown in cropped rice soil from the Branch Station and incubated at the different temperatures. The results (Table 2) show that seedling blighting, as indicated by pre-emergence blighting (seedlings

TABLE 4. EFFECT OF SOIL TEMPERATURES ON SEEDLING BLIGHT IN SUPREME BLUE ROSE SEEDLINGS[1] GROWN IN GREENHOUSE, MARCH 10 TO 27, 1933

Soil temperature	Seeds planted	Seedlings			
		Healthy	Killed before emergence	Total diseased	
Degree C.	*Number*	*Number*	*Number*	*Number*	*Per cent*
18	68	35	12	21	37
22	68	20	9	39	66
26	68	30	1	30	50
30	68	36	4	26	42
34	68	37	0	23	38

[1]From severely-blighted seed grown at Crowley, La., in 1932.

TABLE 5. EFFECT OF SOIL TEMPERATURES ON SEEDLING BLIGHT IN SUPREME BLUE ROSE SEEDLINGS[1] GROWN IN GREENHOUSE, FEBRUARY 18 TO MARCH 8, 1933

Soil temperature	Seeds planted	Seedlings			
		Healthy	Killed before emergence	Total diseased	
Degree C-	*Number*	*Number*	*Number*	*Number*	*Per cent*
15	102	45	0	0	0.0
18	102	56	1	1	1.7
21	85	62	2	4	6.6
24	102	69	1	6	8.0
27	102	42	4	30	42.0

[1]From clean seed grown at Rice Branch Experiment Station in 1932.

[4]The term, "blighted seed," is used to designate seed with discolored glumes, regardless of the fungi involved.

dead or very unlikely to emerge), death of emerged seedlings, or presence of distinct lesions on emerged seedlings near or below the soil line, irrespective of the degree of injury, may occur over a wide temperature range. However, the greatest percentage of blighting occurred at 18° C. Isolations from the diseased seedlings showed that *Fusarium* spp., *Helminthosporium oryzae, Rhizoctonia* sp., and *Pythium* sp. were the probable causes of most of the blighting. The results of the isolation tests (Table 3) indicate that the various fungi causing seedling blight may differ in their ability to produce blighting at the various temperatures. *H. oryzae* was isolated from seedlings grown at temperatures ranging from 18° to 30° C., but caused 60 per cent of the total blighting of seedlings grown at 22° C.; *Fusarium* spp. were isolated from most of the blighted seedlings at temperatures of 30° and 34° C. In view of these results, temperature studies involving different seed lots might not yield identical results due to the fact that microflora of different seed lots may be different.

In the second experiment, severely-blighted Supreme Blue Rose seed from Crowley, Louisiana[5], was used. Isolations from the discolored seed showed that 75 per cent of the blight was due to *Helminthosporium oryzae.* The greatest percentage of blighting occurred at 22° C. These results were not unexpected since isolations from the diseased seedlings showed that 85 per cent of the blighting was due to *H. oryzae.* Ocfemia *(11)* has shown that severe pre-emergence blighting caused by *H. oryzae* takes place at 16° to 24° C. (See Table 4.)

In the third experiment Supreme Blue Rose seed, with very little blight, from the Rice Branch Experiment Station, was sown. The amount of blighting increased as the temperature advanced. These results are not necessarily at variance with the results in Table 4, since *Fusarium* spp., were isolated from 75 per cent of the diseased seedlings; they confirm the evidence presented previously: that the pathogenicity of the different blight-producing fungi may vary at different soil temperatures. (See Table 5.)

In the fourth experiment, moderately to severely-blighted Supreme Blue Rose seed from the Rice Branch Experiment Station was sown in rice soil that had been sterilized, one month previously, by a 1:300 solution of commercial formaldehyde. The total percentage of diseased seedlings at the various temperatures was: 31 at 18° C.; 23 at 22°; 16 at 26°; 10 at 30°; and 12 at 34°. *Helminthosporium oryzae, Fusarium* spp., and *Trichoderma* sp., were isolated from the diseased seedlings. The latter fungus was not encountered in the previous experiments.

The results, as a whole, are in general agreement with the field observations that, in normal seasons, the most serious

[5]Rice Experiment Station, Crowley, Louisiana.

blighting occurs during the early part of the seeding season (in April), when the soil temperature is too cool for rapid germination of the seed and maximum growth of the seedlings.

EFFECT OF DUST TREATMENTS

Greenhouse Experiments

Experiments were conducted in the greenhouse at the Main Station, and in the field at the Rice Branch Experiment Station, to determine the effects of dust disinfectants on seedling emergence, severity of seedling blight, and yield. The yield data were obtained from the field experiments only.

Three experiments were performed in 1935 in the greenhouse to determine the effect of red copper oxide, formaldehyde (active ingredient 6 per cent), and ethyl mercury phosphate (active ingredient 5 per cent) dusts on emergence, severity of seedling blighting, and control of each of the fungi commonly associated with blighting. The seed lots, consisting of 150

Table 6. Effect of Dust Treatments of Mildly, Moderately, and Severely-Blighted Supreme Blue Rose Seed on Seedling Blighting in Greenhouse, March 3 to 17, 1936

Seed treatment compound	Seed blighting	Seedlings			Severity
		Total from 150 seed	Lightly diseased	Severely diseased	
	Degree	*Number*	*Number*	*Number*	
Copper oxide	Mild[1]	118	12	7	173[4]
Formaldehyde	"	120	13	10	176
Ethyl mercury phosphate	"	123	9	2	132
Control	"	121	23	12	198
Copper oxide	Moderate[2]	86	0	2	262
Formaldehyde	"	89	6	9	283
Ethyl mercury phosphate	"	70	5	6	348[5]
Control	"	83	8	8	308
Copper oxide	Severe[3]	112	13	13	217
Formaldehyde	"	93	7	7	263
Ethyl mercury phosphate	"	105	7	1	197
Control	"	104	25	9	261

[1]Seed from Beaumont, Texas.
[2]Seed from Rice Branch Experiment Station, 2 years old.
[3]Seed from Beaumont, Texas.
[4]Index numbers.
[5]Large index number due to seed injury.

blighted seeds, picked from the samples used in the experiments, were thoroughly mixed with the dust in small vials, after which the excess dust was removed by shaking the seed on a wire screen. The treated seed was placed in closed containers for 24 hours and sown in flats. The greenhouse temperatures ranged from 20° to 25° C.

To evaluate the relative severity of the blighting and efficiency of the dusts in controlling seedling blighting, an index number was obtained for each seed lot by adding the products of: (1) the number of lightly-diseased seedlings $\times$ 2, (2) the number of severely-diseased seedlings $\times$ 3, and (3) the number of seed failing to germinate $\times$ 4. The lightly-diseased seedlings were stunted but showed signs of recovery, while the severely-diseased seedlings were either dead or severely stunted. Severely-stunted seedlings may or may not have survived. Readings were taken on the seedlings that had not emerged as well as on the seedlings

TABLE 7. FUNGI ISOLATED FROM DISEASED RICE SEEDLINGS FROM MILDLY, MODERATELY, AND SEVERELY-BLIGHTED SUPREME BLUE ROSE SEED TREATED WITH VARIOUS DUST DISINFECTANTS, GROWN IN GREENHOUSE, MARCH 3 TO 17, 1935

Seed treatment compound	Seed blighting	Total isolations	Fungi					
			Helminthosporium oryzae	Fusarium spp.	Curvularia lunata	Pythium spp.	Penicillium sp.	Rhizoctonia sp.
	Degree	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*	*Number*
Copper oxide	Mild[1]	9	3	3	2	0	1	0
Formaldehyde	"	7	4	1	0	2	0	0
Ethyl mercury phosphate	"	6	0	0	0	1	5	0
Control	"	11	5	3	1	0	2	0
Copper oxide	Moderate[2]	3	0	2	0	0	0	1
Formaldehyde	"	11	0	8	0	0	0	3
Ethyl mercury phosphate	"	13	0	2	0	0	4	7
Control	"	17	0	6	1	1	0	9
Copper oxide	Severe[3]	11	7	3	0	0	1	0
Formaldehyde	"	10	6	2	1	1	0	0
Ethyl mercury phosphate	"	8	0	0	0	1	7	0
Control	"	2	1	1	0	0	0	0

[1]Seed from Beaumont, Texas.
[2]Seed from Rice Branch Experiment Station, 2 years old.
[3]Seed from Beaumont, Texas.

that had emerged. The seedlings that had not emerged were dead or had little chance of recovery.

The first experiment was devised to study the effect of the dust treatments on emergence and control of seedling blight from mildly and severely-blighted Supreme Blue Rose seed from Beaumont, Texas, and moderately-blighted 2-year-old seed from the Rice Branch Experiment Station. The total number of seedlings produced from the different seed lots was not appreciably affected by any of the treatments. However, the severity of seedling infection was reduced in most instances by the treatments. (See Tables 6 and 7.) Isolations from the diseased seedlings

TABLE 8. EFFECT OF DUST TREATMENTS ON THE BLIGHTING OF FORTUNA, CALORO, AND SUPREME BLUE ROSE SEEDLINGS IN GREENHOUSE, MARCH 20 TO APRIL 4, 1936

Variety	Source of seed	Seed treatment compound	Seedlings: Total from 150 seed	Seedlings: Lightly diseased	Seedlings: Severely diseased	Severity
			Number	*Number*	*Number*	
Fortuna	A[1]	Copper oxide	136	8	4	84
"	B[2]	" "	144	28	8	104
"	C[3]	" "	114	29	23	271
"	A	Formaldehyde	146	9	15	79
"	B	"	135	24	12	144
"	C	"	114	44	23	301
"	A	Ethyl mercury phosphate	109[4]	1	9	73
"	B	" " "	139	26	14	138
"	C	" " "	103	8	7	225
"	A	Control	142	13	16	98
"	B	"	134	35	11	177
"	C	"	115	42	48	368
Caloro	A	Copper oxide	123	6	5	115
"	B	" "	128	17	13	161
"	C	" "	101	19	8	258
"	A	Formaldehyde	137	11	15	107
"	B	"	123	25	12	194
"	C	"	104	29	29	329
"	A	Ethyl mercury phosphate	70[5]	0	3	329
"	B	" " "	122	33	18	232
"	C	" " "	114	29	9	229
"	A	Control	137	7	12	102
"	B	"	128	28	10	174
"	C	"	107	29	25	305
Supreme Blue Rose	A	Copper oxide	143	8	6	62
" " "	B	" "	138	32	5	127
" " "	C	" "	116	23	20	242
" " "	A	Formaldehyde	147	12	12	72
" " "	B	"	129	36	13	195
" " "	C	"	119	43	15	255
" " "	A	Ethyl mercury phosphate	113	3	8	178
" " "	B	" " "	106	7	10	220
" " "	C	" " "	94[5]	17	3	267
" " "	A	Control	140	7	6	52
" " "	B	"	138	23	2	100
" " "	C	"	108	34	13	275

[1]Rice Branch Experiment Station.
[2]Crowley, Louisiana.
[3]Beaumont, Texas.
[4]Only 135 seed sown.
[5]Seed injury from dust.

TABLE 9. FUNGI ISOLATED FROM DISEASED FORTUNA, CALORO, AND SUPREME BLUE ROSE SEEDLINGS FOLLOWING SEED TREATMENT WITH VARIOUS DUSTS

Variety	Source of seed	Treatment	Fungi: Helminthosporium oryzae	Fusarium spp.	Rhizoctonia sp.	Penicillium spp.	Trichoderma sp.	Curvularia lunata	Curvularia maculans	Cephalosporium sp.	Phoma sp.	Pythium spp.	Total isolations
			Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	
Fortuna	A[1]	Copper oxide	7.7	23.1	38.5	15.4	0.0	0.0	0.0	15.4	0.0	0.0	13
"	A	Formaldehyde	12.5	20.8	45.8	0.0	0.0	8.3	0.0	0.0	0.0	12.5	24
"	A	Ethyl mercury phosphate	0.0	33.5	0.0	0.0	33.3	0.0	0.0	33.3	0.0	0.0	3
"	A	Control	14.3	46.4	28.6	0.0	0.0	10.7	0.0	0.0	0.0	0.0	28
"	B[2]	Copper oxide	13.0	39.1	26.1	8.7	0.0	0.0	0.0	13.0	0.0	0.0	23
"	B	Formaldehyde	25.0	10.7	21.4	32.1	3.6	3.6	0.0	0.0	3.6	0.0	28
"	B	Ethyl mercury phosphate	29.7	29.7	29.7	8.1	0.0	0.0	0.0	2.7	0.0	0.0	37
"	B	Control	8.1	32.4	27.0	5.4	2.7	5.4	0.0	10.8	8.1	0.0	37
"	C[3]	Copper oxide	68.2	13.6	13.6	0.0	0.0	2.3	0.0	2.3	0.0	0.0	44
"	C	Formaldehyde	84.2	5.3	5.3	1.8	1.8	0.0	0.0	0.0	1.8	0.0	57
"	C	Ethyl mercury phosphate	0.0	0.0	0.0	78.6	0.0	0.0	0.0	0.0	0.0	21.4	14
"	C	Control	79.7	12.2	2.7	0.0	4.1	1.4	0.0	0.0	0.0	0.0	74
Caloro	A	Copper oxide	0.0	14.3	14.3	0.0	0.0	14.3	0.0	14.3	28.6	14.3	7
"	A	Formaldehyde	0.0	36.0	44.0	4.0	0.0	12.0	0.0	4.0	0.0	0.0	25
"	A	Ethyl mercury phosphate	0.0	33.3	0.0	0.0	33.3	0.0	0.0	33.3	0.0	0.0	3
"	A	Control	20.0	10.0	70.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10
"	B	Copper oxide	17.4	21.7	8.7	26.1	0.0	0.0	0.0	8.7	13.0	4.3	23
"	B	Formaldehyde	5.6	44.4	30.5	2.8	11.1	5.5	0.0	0.0	0.0	0.0	36
"	B	Ethyl mercury phosphate	6.1	51.5	24.2	12.1	0.0	3.0	3.0	0.0	0.0	0.0	33
"	B	Control	25.0	40.6	28.1	0.0	6.3	0.0	0.0	0.0	0.0	0.0	32
"	C	Copper oxide	42.9	14.3	23.8	0.0	9.5	4.8	0.0	4.8	0.0	0.0	21
"	C	Formaldehyde	79.6	12.2	8.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49
"	C	Ethyl mercury phosphate	59.4	28.1	6.3	6.3	0.0	0.0	0.0	0.0	0.0	0.0	32
"	C	Control	68.6	9.8	5.9	5.9	2.0	2.0	2.0	3.9	0.0	0.0	51
Supreme Blue Rose	A	Copper oxide	0.0	13.3	66.7	6.7	0.0	0.0	13.3	0.0	0.0	0.0	15
"	A	Formaldehyde	0.0	33.3	42.9	14.8	0.0	0.0	9.5	0.0	9.5	0.0	21
"	A	Ethyl mercury phosphate	0.0	0.0	90.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	10
"	A	Control	8.3	16.7	75.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12
"	B	Copper oxide	13.8	41.4	20.7	10.3	0.0	0.0	0.0	13.8	0.0	0.0	29
"	B	Formaldehyde	4.3	43.4	21.7	0.0	0.0	13.0	0.0	4.3	4.3	8.7	23
"	B	Ethyl mercury phosphate	0.0	22.2	16.7	61.1	0.0	0.0	0.0	0.0	0.0	0.0	18
"	B	Control	31.6	31.6	21.1	0.0	0.0	5.3	0.0	5.3	5.3	0.0	19
"	C	Copper oxide	44.4	0.0	29.6	14.8	3.7	0.0	0.0	7.4	0.0	0.0	27
"	C	Formaldehyde	37.0	39.1	6.5	8.7	0.0	2.2	0.0	4.3	2.2	0.0	46
"	C	Ethyl mercury phosphate	0.0	20.8	25.0	54.2	0.0	0.0	0.0	0.0	0.0	0.0	24
"	C	Control	34.4	8.5	6.4	0.0	51.1	0.0	0.0	0.0	0.0	0.0	47

[1]Rice Branch Experiment Station.
[2]Crowley, Louisiana.
[3]Beaumont, Texas.

(Table 7) indicate that ethyl mercury phosphate reduced the number of infections due to *Helminthosporium oryzae* and *Fusarium* spp.

In the second experiment, moderately-blighted Fortuna, Caloro, and Supreme Blue Rose seed from the Rice Branch Experiment Station, from Crowley, Louisiana, and from Beaumont, Texas, was sown. The results agree with those presented in Table 6, in that the total number of seedlings was not increased by the treatments (Table 8). The treatments reduced the severity of blight of seedlings grown from Fortuna seed from the Branch Station, Crowley, and Beaumont, and from the Caloro and Supreme Blue Rose seed from Beaumont, but failed to reduce the severity of infection on seedlings grown from Caloro and Supreme Blue Rose seed from the Branch Station and Crowley. Such inconsistencies are probably due to variations in the microflora of various seed lots. The fungi isolated from the diseased seedlings are shown in Table 9. Ethyl mercury phosphate and copper oxide reduced the per cent of blighting due to *Helminthosporium oryzae;* otherwise, the results fail to show any super-

TABLE 10. EFFECT OF DUST TREATMENTS ON EMERGENCE AND SEVERITY OF SEEDLING BLIGHT OF SUPREME BLUE ROSE GROWN IN THE GREENHOUSE IN STERILIZED AND NON-STERILIZED SOIL, APRIL 10 TO 23, 1936

Source of seed	Dust treatment	Soil	Seedlings Total	Mildly diseased	Severely diseased	Severity
			Number	Number	Number	
A[1]	Copper oxide	Sterilized	130	9	0	98
A	Formaldehyde	"	145	4	0	28
A	Ethyl mercury phosphate	"	104	8	5	215
A	Control	"	120	18	3	165
B[2]	Copper oxide	"	124	18	3	149
B	Formaldehyde	"	113	20	4	200
B	Ethyl mercury phosphate	"	118	3	11	167
B	Control	"	98	23	12	290
C[3]	Copper oxide	"	120	11	6	160
C	Formaldehyde	"	75	26	20	412
C	Ethyl mercury phosphate	"	92	27	8	310
C	Control	"	52	30	34	552
A	Copper oxide	Non-sterilized	117	18	3	177
A	Formaldehyde	"	131	8	6	110
A	Ethyl mercury phosphate	"	98	5	12	254
A	Control	"	116	13	7	183
B	Copper oxide	"	110	28	7	237
B	Formaldehyde	"	99	24	11	285
B	Ethyl mercury phosphate	"	111	4	3	173
B	Control	"	109	26	7	237
C	Copper oxide	"	92	22	8	300
C	Formaldehyde	"	77	24	25	415
C	Ethyl mercury phosphate	"	104	5	4	206
C	Control	"	75	33	19	423

[1]Rice Branch Experiment Station.
[2]Crowley, Louisiana.
[3]Beaumont, Texas.

TABLE 11. FUNGI ISOLATED FROM DISEASED SUPREME BLUE ROSE SEEDLINGS FROM TREATED SEED SOWN IN THE GREENHOUSE IN STERILIZED AND NON-STERILIZED SOIL, APRIL 10 TO 23, 1936

Source of seed	Seed treatment	Soil treatment	Total isolations	Fungi isolated from diseased seedlings							
				Helminthosporium oryzae	Fusarium spp.	Rhizoctonia sp.	Penicillium sp.	Curvularia lunata	Pythium spp.	Trichoderma sp.	Phoma sp.
				Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
A[1]	Copper oxide	Sterilized	9	0.0	0.0	0.0	0.0	0.0	0.0	77.7	22.2
A	Formaldehyde	"	8	25.0	0.0	0.0	0.0	0.0	0.0	75.0	0.0
A	Ethyl mercury phosphate	"	8	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
A	Control	"	22	9.1	0.0	0.0	4.5	0.0	0.0	81.8	4.5
B[2]	Copper oxide	"	25	12.0	4.0	0.0	0.0	0.0	0.0	52.0	32.0
B	Formaldehyde	"	25	20.0	8.0	0.0	0.0	0.0	0.0	64.0	0.0
B	Ethyl mercury phosphate	"	7	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
B	Control	"	28	28.6	3.6	0.0	3.6	0.0	0.0	64.3	0.0
C[3]	Copper oxide	"	15	26.7	0.0	0.0	0.0	0.0	0.0	73.3	0.0
C	Formaldehyde	"	42	28.5	0.0	0.0	0.0	0.0	0.0	71.4	0.0
C	Ethyl mercury phosphate	"	13	0.0	0.0	0.0	0.0	0.0	0.0	100.0	0.0
C	Control	"	60	50.0	6.7	1.7	8.3	3.3	0.0	30.0	0.0
A	Copper oxide	Non-sterilized	21	42.9	9.5	8.5	28.6	0.0	0.0	9.5	0.0
A	Formaldehyde	"	11	18.2	36.4	18.2	9.1	0.0	0.0	18.2	0.0
A	Ethyl mercury phosphate	"	14	0.0	0.0	35.7	57.1	0.0	7.1	0.0	0.0
A	Control	"	19	26.3	47.4	15.8	0.0	10.5	0.0	0.0	0.0
B	Copper oxide	"	28	53.6	21.4	0.0	7.1	7.1	0.0	7.1	3.6
B	Formaldehyde	"	19	10.5	47.4	15.8	10.5	5.3	0.0	10.5	0.0
B	Ethyl mercury phosphate	"	3	0.0	0.0	0.0	66.6	0.0	33.3	0.0	0.0
B	Control	"	20	40.0	25.0	5.0	10.0	5.0	0.0	10.0	5.0
C	Copper oxide	"	32	37.5	9.4	6.3	37.5	3.1	0.0	6.3	0.0
C	Formaldehyde	"	43	58.1	14.0	7.0	4.7	0.0	0.0	11.6	4.7
C	Ethyl mercury phosphate	"	7	0.0	28.6	0.0	57.1	0.0	0.0	14.3	0.0
C	Control	"	49	67.3	24.5	2.0	4.1	0.0	0.0	2.0	0.0

[1]Rice Branch Experiment Station.
[2]Crowley, Louisiana.
[3]Beaumont, Texas.

iority of one dust over another in the control of any specific fungus.

The third greenhouse experiment dealt with the effect of dusts on the emergence and percentage of seedling infection of Supreme Blue Rose from the Branch Station, Crowley, and Beaumont on sterilized and non-sterilized soil. The dusts increased the total number of seedlings and reduced the percentage of seedling infection in 8 out of 9 cases on sterilized soil and in 5 out of 9 cases on non-sterilized soil (Table 10). From the isolation experiments (Table 11), it was evident that blighting due to *Helminthosporium oryzae* was completely controlled by ethyl mercury phosphate. The results, as a whole, emphasize the fact that the beneficial results of the treatments in reducing infection were due essentially to the control of the seed-borne fungi. In this connection *H. oryzae* was classified as seed-borne and *Rhizoctonia* sp. and *Fusarium* spp. as soil-borne, the latter also being seed-borne in some instances.

Field Experiments

Field studies were conducted at the Rice Branch Experiment Station during 1933 and 1934 to determine the effect of various dust treatments on the emergence, severity of seedling blight, and yield of Supreme Blue Rose. Small lots of seed were treated with the dusts, at the rates recommended by the manufacturers,

Table 12. Effect of Dust Seed Treatments on the Stand and Yield of Supreme Blue Rose at Rice Branch Experiment Station, 1933 and 1934

Seed treatment compound	Date of seeding	Emergence count on 24-foot row[1]		Yield in bushels per acre[1]	
		1933	*1934*	*1933*	*1934*
Formaldehyde	April	146	94	66	23
	May	110	233	44	27
	June	204	349	50	30
Ethyl mercury chloride	April	147	91	71	13
	May	125	177	46	25
	June	195	297	51	28
Ethyl mercury phosphate	April	204	110	67	14
	May	120	363	42	30
	June	207	313	49	27
Copper-lime	April	150	78	67	10
	May	125	264	50	35
	June	179	381	41	30
No treatment	April	137	115	63	22
	May	105	271	42	31
	June	201	389	50	28

[1]Averages of quadruplicated plots.

TABLE 13. EFFECT OF DUST SEED TREATMENTS ON PERCENTAGE OF SEEDLING BLIGHT, EMERGENCE, AND HEIGHT OF SUPREME BLUE ROSE SEEDLINGS, AND YIELD OF RICE AT THE RICE BRANCH EXPERIMENT STATION, 1935

Dust	Date	Seedlings						Emergence count on 15-foot rows	Yield per acre
		Total	Healthy	Lightly diseased	Severely diseased	Height			
						Healthy	Diseased		
		Number	*Per cent*	*Per cent*	*Per cent*	*Inches*	*Inches*	*Number*[1]	*Bushels*[1]
Formaldehyde	April	158	28	43	29	3.7	3.2	87	44.6
	May	120	0	42	58			112	43.0
Ethyl mercury chloride	April	139	43	30	27	3.8	3.2	102	41.6
	May	119	0	67	33			115	40.3
Ethyl mercury phosphate	April	169	32	37	31	3.8	3.4	106	38.9
	May	124	0	55	45			109	42.0
Copper oxide	April	159	40	44	16	3.7	3.3	101	43.8
	May	122	0	27	73			117	39.5
No treatment	April	158	42	39	19	3.7	3.3	94	40.0
	May	116	0	38	62			97	41.8

[1]Average of quadruplicated plots.

and sown at the rate of 8 pecks per acre in 1/200 acre randomized quadruplicated plots. In 1933, the treatments resulted in a slight increase in seedling emergence as well as yield in the plots sown in April and May, but failed to increase either seedling emergence or yield in the plots sown in June. The treatments in 1934 failed to produce any increase in seedling emergence or yield regardless of the date of seeding. The negative yield results in 1934 were due in part to the extreme grassy condition of the experimental plots. (See Table 12.)

In 1935, the experiment was carried out in the usual manner; however, data were taken on the percentage of diseased seedlings and the height of the seedlings as well as emergence and yield. The treatments slightly increased the stands but failed, in most instances, to reduce the percentage of diseased seedlings or increase the height of the seedlings. The results of the treatments on yield show that formaldehyde and copper oxide increased the yields approximately 4 bushels per acre on the plots sown in April. (See Table 13.) An additional experiment was conducted in 1935 using Supreme Blue Rose, Fortuna, and Caloro seed grown at Beaumont, Texas. The experimental methods were modified in that, for the emergence data, lots of 100 seeds were treated and sown in triplicated randomized rod rows, and for the yield data small lots of seed were treated and drilled at the rate of 8 pecks per acre in triplicated randomized rod rows. The treatments failed to result in any consistent increase in stand or yield. (See Table 14.)

Field results in 1936 on the effect of dust treatments on seedling emergence, severity of seedling infection, and yield of Caloro, Fortuna, and Supreme Blue Rose are tabulated in detail

TABLE 14. EFFECT OF DUST SEED TREATMENT ON THE EMERGENCE AND YIELD OF CALORO, FORTUNA, AND SUPREME BLUE ROSE RICE AT THE RICE BRANCH EXPERIMENT STATION, 1935

Variety	Seed treatment compound	Emergence and acre yield			
		Sown in April		Sown in May	
		Per cent[1]	*Bushels*[1]	*Per cent*[1]	*Bushels*[1]
Caloro[2]	Ethyl mercury phosphate	44.6	-----[3]	0.6[3]	59.6
	Formaldehyde	39.6	[3]	46.6	69.8
	Control	39.6	57.3	47.6	62.3
Fortuna[2]	Ethyl mercury phosphate	53.6	52.9	1.3[3]	68.3
	Formaldehyde	41.6	51.4	58.0	60.0
	Control	43.3	55.6	55.3	82.2
Supreme Blue Rose[2]	Ethyl mercury phosphate	40.0	54.5	3.3[3]	49.6
	Formaldehyde	41.3	62.7	50.0	39.4
	Control	40.6	57.6	56.0	46.4

[1]Average of triplicated plots.
[2]Seed from Beaumont, Texas.
[3]Seed injury due to excess dust.

TABLE 15. EFFECT OF DUST TREATMENTS ON SEEDLING EMERGENCE, SEVERITY OF SEEDLING INFECTION, AND YIELD OF CALORO, FORTUNA, AND SUPREME BLUE ROSE RICE AT THE RICE BRANCH EXPERIMENT STATION, 1936

Variety	Source of seed	Date of seeding	Treatment	Plants: Emergence	Plants: Healthy	Plants: Mildly diseased	Plants: Severely diseased	Plants: Severity rating	Yield per acre
				Number	*Number*	*Number*	*Number*		*Bushels*
Caloro	Rice Branch Experiment Station	April	Copper oxide	49.0[1]	15.3[1]	20.0[1]	13.6[1]	285.0[1]	——[3]
"	" "	"	Formaldehyde	54.6	15.6	20.0	19.0	278.3	——[3]
"	" "	"	Ethyl mercury phosphate	43.3	9.3	21.0	13.0	307.6	——[3]
"	" "	"	Control	45.6	5.6	25.3	13.3	312.0	——[3]
Fortuna	" "	"	Copper oxide	32.3	12.0	11.3	9.0	320.3	——[3]
"	" "	"	Formaldehyde	37.3	12.6	15.6	11.0	307.0	——[3]
"	" "	"	Ethyl mercury phosphate	31.6	16.6	10.0	5.0	308.3	——[3]
"	" "	"	Control	38.0	13.6	14.3	9.6	306.3	——[3]
Supreme Blue Rose	" "	"	Copper oxide	54.6	18.3	25.0	11.3	235.3	34.9[1]
" " "	" "	"	Formaldehyde	47.3	9.3	26.0	12.0	298.6	43.9
" " "	" "	"	Ethyl mercury phosphate	38.0	18.0	16.0	3.0	292.0	53.4
" " "	" "	"	Control	39.3	9.0	20.3	10.0	313.3	39.6
Caloro	Beaumont, Texas	April	Copper oxide	31.6	7.0	15.6	9.0	331.6	——[3]
"	" "	"	Formaldehyde	24.3	9.6	10.0	4.6	336.6	——[3]
"	" "	"	Ethyl mercury phosphate	30.6	3.6	15.0	12.0	343.3	——[3]
"	" "	"	Control	33.3	12.0	18.3	3.3	312.0	——[3]
Fortuna	" "	"	Copper oxide	30.6	10.3	11.3	9.0	327.0	36.0
"	" "	"	Formaldehyde	29.0	6.6	15.0	7.3	336.0	29.8
"	" "	"	Ethyl mercury phosphate	38.6	16.6	15.3	6.6	296.0	38.9
"	" "	"	Control	29.0	11.0	13.3	4.3	324.3	29.0
Supreme Blue Rose	" "	"	Copper oxide	18.0	4.6	9.3	6.0	364.6	35.6
" " "	" "	"	Formaldehyde	30.3	8.0	12.3	10.0	333.3	34.8
" " "	" "	"	Ethyl mercury phosphate	16.3	1.3	8.6	6.3	371.0	42.1
" " "	" "	"	Control	22.0	4.0	12.3	5.6	353.6	46.3

TABLE 15. EFFECT OF DUST TREATMENTS ON SEEDLING EMERGENCE, SEVERITY OF SEEDLING INFECTION, AND YIELD OF CALORO, FORTUNA, AND SUPREME BLUE ROSE RICE AT THE RICE BRANCH EXPERIMENT STATION, 1936—*(Continued)*

Variety	Source of seed	Date of seeding	Treatment	Plants: Emergence	Plants: Healthy	Plants: Mildly diseased	Plants: Severely diseased	Plants: Severity rating	Yield per acre
				Number	*Number*	*Number*	*Number*		*Bushels*
Caloro	Rice Branch Experiment Station	May	Copper oxide	27.0[2]	17.4[2]	6.2[2]	3.4[2]	314.6[2]	——[3]
"	" "	"	Formaldehyde	21.4	11.8	5.2	4.4	338.0	——[3]
"	" "	"	Ethyl mercury phosphate	18.6	14.4	3.6	0.6	334.6	——[3]
"	" "	"	Control	24.2	15.2	5.4	3.6	324.8	——[3]
Fortuna	" "	"	Copper oxide	19.4	17.0	1.8	0.6	327.8	38.9[2]
"	" "	"	Formaldehyde	27.2	20.6	5.4	1.2	305.6	49.0
"	" "	"	Ethyl mercury phosphate	28.0	24.8	3.0	0.2	294.6	41.2
"	" "	"	Control	29.8	23.8	4.0	2.0	294.8	50.9
Supreme Blue Rose	" "	"	Copper oxide	29.8	22.0	5.4	2.4	298.8	63.7
" " "	" "	"	Formaldehyde	29.2	23.2	4.2	1.8	297.0	38.9
" " "	" "	"	Ethyl mercury phosphate	26.2	20.8	3.8	1.6	307.6	53.1
" " "	" "	"	Control	25.8	19.4	4.2	2.2	311.8	41.2
Caloro	Beaumont, Texas	May	Copper oxide	21.6	12.0	7.0	2.6	335.4	51.1
"	" "	"	Formaldehyde	14.6	7.8	4.0	3.0	362.6	53.5
"	" "	"	Ethyl mercury phosphate	8.5	4.8	3.2	0.4	376.0	45.1
"	" "	"	Control	22.0	12.8	6.6	2.6	333.0	49.4
Fortuna	" "	"	Copper oxide	14.4	8.4	3.6	2.4	356.8	52.3
"	" "	"	Formaldehyde	14.4	9.2	3.4	1.8	354.6	54.5
"	" "	"	Ethyl mercury phosphate	15.8	12.4	3.2	0.2	347.8	46.5
"	" "	"	Control	13.6	9.8	2.8	1.0	354.2	57.3
Supreme Blue Rose	" "	"	Copper oxide	27.2	15.6	10.4	1.2	317.0	40.8
" " "	" "	"	Formaldehyde	19.2	13.0	4.6	2.2	336.6	63.4
" " "	" "	"	Ethyl mercury phosphate	17.0	12.8	3.6	0.6	341.0	42.3
" " "	" "	"	Control	21.2	15.6	4.6	1.0	327.4	55.9

[1]Averages of 3 replications.
[2]Averages of 5 replications.
[3]Grain destroyed by birds.

in Table 15. The severity rating was based upon an index number obtained by adding the products of (1) the number of lightly-diseased seedlings × 2, (2) the number of severely-diseased seedlings × 3, and (3) the number of seed failing to germinate plus the number of seedlings failing to emerge × 4. Readings were taken only on emerged seedlings. The lightly-diseased seedlings were slightly stunted but showed signs of recovery. The severely-diseased lot included the dead and severely-stunted seedlings; the latter may or may not have survived. The experimental methods were the same as those used in the second experiment in 1935. The different seed lots responded differently to the treatments with reference to seedling emergence, severity of seedling infection, and yield. A brief summary of the greenhouse and field work in 1936 is presented in Table 16. These results emphasize the facts, previously presented, that, although the dust treatments, especially ethyl mercury phosphate and copper oxide, may increase seedling emergence and reduce the severity of blighting, the yields may not be increased accordingly. No doubt variable

TABLE 16. SUMMARY OF THE EFFECT OF DUST SEED TREATMENTS ON SEEDLING EMERGENCE, PERCENTAGE OF DISEASED SEEDLINGS, AND YIELD OF SUPREME BLUE ROSE, FORTUNA, AND CALORO RICE GROWN IN THE GREENHOUSE AT THE MAIN STATION, AND AT THE RICE BRANCH EXPERIMENT STATION, 1936

Variety and seed treatment	Seedlings[1]				Acre yield[1] in field
	Emerged		Diseased		
	Greenhouse	Field	Greenhouse	Field	
	Number	*Number*	*Per cent*	*Per cent*	*Bushels*
Supreme Blue Rose					
Check	1169	198	17	73	45
Ethyl mercury phosphate	986	203	9	29	47
Formaldehyde	1168	231	19	69	44
Copper oxide	1181	250	15	44	43
Fortuna					
Check	392	145	33	60	45
Ethyl mercury phosphate	333	188	15	32	41
Formaldehyde	391	162	29	65	43
Copper oxide	397	170	19	51	41
Caloro					
Check	369	223	24	65	49
Ethyl mercury phosphate	296	220	24	34	45
Formaldehyde	358	217	26	66	53
Copper oxide	318	210	17	47	51
Averages					
Check	1930[2]	188.7	24.7	66.0	46.3
Ethyl mercury phosphate	1615[2]	203.7	12.7	31.7	44.3
Formaldehyde	1917[2]	203.3	24.7	66.7	46.7
Copper oxide	1896[2]	210.0	17.0	47.3	45.0

[1]Combined data from all seed lots.
[2]Total number.

TABLE 17. SUMMARY OF FUNGI ISOLATED FROM DISEASED RICE SEEDLINGS GROWN IN FIELD AT THE RICE BRANCH EXPERIMENT STATION FROM TREATED SEED, 1934 TO 1936

Variety	Date of seeding	Seed treatment compound	Total isolations	Fungi isolated at indicated frequencies: Helminthosporium	Fusarium spp.	Rhizoctonia sp.	Penicillium sp.	Curvularia lunata	Curvularia maculans	Pythium spp.	Phoma sp.	Alternaria sp.
				Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
Supreme Blue Rose	April, 1934	Formaldehyde	28	0.0	46.4	50.0	0.0	0.0	0.0	3.6	0.0	0.0
" " "	May, 1934	"	6	0.0	33.3	33.3	0.0	0.0	0.0	33.6	0.0	0.0
" " "	June, 1934	"	10	20.0	40.0	0.0	0.0	40.0	0.0	0.0	0.0	0.0
" " "	April, 1935	"	34	2.9	38.2	41.1	0.0	5.8	0.0	11.7	0.0	0.0
" " "	May, 1935	"	44	2.2	81.1	6.8	0.0	2.2	0.0	6.8	0.0	0.0
" " "	April, 1936	"	62	8.1	21.0	16.1	27.4	11.3	1.6	3.2	3.2	8.1
Caloro	April, 1936	"	50	0.0	32.0	2.0	38.0	14.0	2.0	2.0	6.0	4.0
Fortuna	April, 1936	"	53	3.8	35.8	7.5	18.9	11.3	0.0	7.5	7.5	13.2
Supreme Blue Rose	May, 1936	"	30	0.0	60.0	3.3	20.0	10.0	0.0	0.0	0.0	6.7
Caloro	May, 1936	"	48	0.0	50.0	0.0	29.2	10.4	0.0	0.0	2.1	8.3
Fortuna	May, 1936	"	35	0.0	45.7	0.0	17.1	25.7	0.0	0.0	2.9	8.6
Supreme Blue Rose[1]	April, 1936	"	78	17.9	39.7	10.3	21.8	2.6	2.6	2.6	0.0	2.6
Caloro[1]	April, 1936	"	54	53.7	24.1	1.9	14.8	0.0	3.7	1.9	0.0	0.0
Fortuna[1]	April, 1936	"	19	47.4	15.8	5.3	26.3	0.0	5.3	0.0	0.0	0.0
Supreme Blue Rose[1]	May, 1936	"	28	25.0	32.1	3.5	32.1	7.0	0.0	0.0	0.0	0.0
Caloro[1]	May, 1936	"	39	38.5	10.3	2.6	48.7	0.0	0.0	0.0	0.0	0.0
Fortuna[1]	May, 1936	"	24	75.0	12.5	0.0	4.2	8.3	0.0	0.0	0.0	0.0
Supreme Blue Rose	April, 1934	Ethyl mercury chloride	24	0.0	29.1	70.8	0.0	0.0	0.0	0.0	0.0	0.0
" " "	May, 1934		11	0.0	63.6	9.0	0.0	0.0	0.0	27.0	0.0	0.0
" " "	June, 1934	"	17	0.0	64.0	0.0	0.0	36.0	0.0	0.0	0.0	0.0
" " "	April, 1935	"	26	0.0	19.2	69.2	0.0	0.0	0.0	11.5	0.0	0.0
" " "	May, 1935	"	50	0.0	88.0	0.0	0.0	4.0	0.0	8.0	0.0	0.0
Supreme Blue Rose	April, 1934	Ethyl mercury phosphate	20	0.0	20.0	75.0	0.0	0.0	0.0	5.0	0.0	0.0
" " "	May, 1934		5	0.0	40.0	20.0	0.0	0.0	0.0	40.0	0.0	0.0
" " "	June, 1934	"	7	0.0	71.0	0.0	0.0	29.0	0.0	0.0	0.0	0.0
" " "	April, 1935	"	46	21.0	21.7	69.5	0.0	0.0	2.1	6.5	0.0	0.0
" " "	May, 1935	"	52	0.0	86.5	5.8	0.0	7.7	0.0	0.0	0.0	0.0
" " "	April, 1936	"	19	10.5	26.3	10.5	15.8	5.3	0.0	15.8	10.5	5.3
Caloro	April, 1936	"	25	4.0	32.0	12.0	16.0	16.0	0.0	0.0	0.0	20.0
Fortuna	April, 1936	"	19	0.0	31.6	21.0	21.0	10.5	0.0	0.0	0.0	15.8
Supreme Blue Rose	May, 1936	"	18	0.0	50.0	5.6	22.2	11.1	0.0	0.0	0.0	11.1
Caloro	May, 1936	"	17	0.0	47.1	0.0	35.3	17.6	0.0	0.0	0.0	0.0
Fortuna	May, 1936	"	14	0.0	57.1	0.0	14.3	21.4	0.0	0.0	0.0	7.1
Supreme Blue Rose[1]	April, 1936	"	29	3.4	24.1	3.4	58.6	3.4	0.0	6.9	0.0	0.0
Caloro[1]	April, 1936	"	22	18.2	27.3	4.5	45.5	0.0	0.0	0.0	0.0	4.5
Fortuna[1]	May, 1936	"	30	20.0	30.0	20.0	23.3	0.0	0.0	3.3	0.0	3.3
Supreme Blue Rose[1]	May, 1936	"	16	0.0	31.3	0.0	68.8	0.0	0.0	0.0	0.0	0.0

TABLE 17. SUMMARY OF FUNGI ISOLATED FROM DISEASED RICE SEEDLINGS GROWN IN FIELD AT THE RICE BRANCH EXPERIMENT STATION FROM TREATED SEED, 1934 TO 1936—*(Continued)*

Variety	Date of seeding	Seed treatment compound	Total isolations	Fungi isolated at indicated frequencies: Helminthosporium	Fusarium spp.	Rhizoctonia sp.	Penicillium sp.	Curvularia lunata	Curvularia maculans	Pythium spp.	Phoma sp.	Alternaria sp.
				Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Caloro[1]	May, 1936	"	20	5.0	5.0	0.0	80.0	0.0	0.0	0.0	0.0	10.0
Fortuna[1]	May, 1936	"	10	20.0	0.0	0.0	70.0	0.0	0.0	0.0	0.0	10.0
Supreme Blue Rose	April, 1934	Copper lime	16	6.2	37.5	50.0	0.0	0.0	0.0	6.2	0.0	0.0
" " "	May, 1934	"	17	0.0	35.3	11.8	0.0	0.0	0.0	53.0	0.0	0.0
" " "	June, 1934	"	11	9.1	72.7	0.0	0.0	18.2	0.0	0.0	0.0	0.0
Supreme Blue Rose	April, 1935	Copper oxide	27	7.4	44.4	40.7	0.0	3.7	0.0	3.7	0.0	0.0
" " "	May, 1935	"	69	0.0	86.9	1.4	0.0	2.9	1.4	7.2	0.0	0.0
" " "	April, 1936	"	36	2.8	36.1	6.7	27.7	5.6	0.0	0.0	2.8	8.3
Caloro	April, 1936	"	40	0.0	17.5	17.5	30.0	15.0	0.0	0.0	17.5	2.5
Fortuna	April, 1936	"	38	5.2	34.2	10.5	26.3	13.2	0.0	0.0	0.0	10.5
Supreme Blue Rose	May, 1936	"	30	0.0	53.3	0.0	23.3	10.0	0.0	0.0	3.3	10.0
Caloro	May, 1936	"	46	0.0	56.5	0.0	17.4	4.3	0.0	0.0	4.3	17.4
Fortuna	May, 1936	"	13	0.0	46.2	0.0	7.7	30.8	0.0	0.0	7.7	7.7
Supreme Blue Rose[1]	April, 1936	"	50	56.0	24.0	6.0	12.0	2.0	0.0	0.0	0.0	0.0
Caloro[1]	April, 1936	"	55	14.5	16.4	1.8	47.3	7.3	0.0	0.0	10.9	1.8
Fortuna[1]	April, 1936	"	41	31.7	22.0	4.9	39.0	0.0	0.0	2.4	0.0	0.0
Supreme Blue Rose[1]	May, 1936	"	22	59.1	22.7	4.5	9.1	4.5	0.0	0.0	0.0	0.0
Caloro[1]	May, 1936	"	39	38.5	25.6	2.6	25.6	5.1	2.6	0.0	0.0	0.0
Fortuna[1]	May, 1936	"	25	64.0	4.0	0.0	28.0	4.0	0.0	0.0	0.0	0.0
Supreme Blue Rose	April, 1934	Control	27	0.0	26.0	55.5	0.0	14.8	0.0	3.7	0.0	0.0
" " "	May, 1934	"	10	0.0	20.0	10.0	0.0	0.0	0.0	70.0	0.0	0.0
" " "	June, 1934	"	10	0.0	50.0	0.0	0.0	50.0	0.0	0.0	0.0	0.0
" " "	April, 1935	"	33	3.0	39.4	30.3	0.0	3.0	3.0	21.2	0.0	0.0
" " "	May, 1935	"	62	0.0	77.4	1.6	0.0	17.7	0.0	3.2	0.0	0.0
" " "	April, 1936	"	54	9.3	11.1	13.0	46.3	9.3	0.0	1.9	0.0	9.2
Caloro	April, 1936	"	53	0.0	24.5	13.2	34.0	11.3	1.9	3.8	5.7	5.7
Fortuna	April, 1936	"	34	0.0	52.9	17.6	17.6	8.8	2.9	0.0	0.0	0.0
Supreme Blue Rose	May, 1936	"	26	3.8	38.5	3.8	7.7	26.9	0.0	0.0	7.7	7.7
Caloro	May, 1936	"	46	0.0	65.2	0.0	6.5	8.7	0.0	0.0	10.9	0.0
Fortuna	May, 1936	"	31	0.0	49.4	19.4	0.0	9.7	0.0	0.0	0.0	22.6
Supreme Blue Rose[1]	April, 1936	"	92	10.9	40.2	10.9	25.0	8.7	2.2	2.2	0.0	0.0
Caloro[1]	April, 1936	"	53	18.9	18.9	20.8	37.7	3.8	0.0	0.0	0.0	0.0
Fortuna[1]	April, 1936	"	40	32.5	40.0	5.0	7.5	7.5	0.0	0.0	7.5	0.0
Supreme Blue Rose[1]	May, 1936	"	25	16.0	36.0	0.0	40.0	4.0	0.0	0.0	0.0	4.0
Caloro[1]	May, 1936	"	45	31.1	33.3	0.0	22.2	13.3	0.0	0.0	0.0	0.0
Fortuna[1]	May, 1936	"	20	45.0	20.0	0.0	10.0	25.0	0.0	0.0	0.0	0.0

[1]Seed from Beaumont, Texas. All other seed lots from Rice Branch Experiment Station.

factors such as the microflora of the seed and soil, and environment, especially soil temperature and moisture, play an important part in determining the efficacy of the seed treatments.

The fungi isolated from the variously treated plots from 1934 to 1936 are shown in Table 17. The results obtained in 1934 and 1935 are indifferent since no particular dust appeared to reduce the percentage of blighting due to any one fungus. However, in 1936, when a large number of isolations were made, copper oxide, formaldehyde, and ethyl mercury phosphate reduced the percentage of blighting due to *Fusarium* spp.; copper oxide reduced the percentage of blighting due to *Rhizoctonia* sp.; and ethyl mercury phosphate reduced the percentage of blighting due to *Helminthosporium oryzae*, where seed from Beaumont was sown.

SUMMARY

Fusarium spp., *Helminthosporium oryzae*, *Rhizoctonia* sp., and *Curvularia lunata* were the fungi most consistently isolated from diseased rice seedlings. Since, according to previously reported experiments, *H. oryzae*, *Trichoconis caudata*, *C. lunata*, *Fusarium* spp. and *Phoma* sp., were found most consistently in discolored rice kernels, the fungi found in association with diseased seedlings, with the exception of *Rhizoctonia* sp., may be seed-borne.

Seedling blighting occurred at soil temperatures ranging from 18° to 34° C. The most severe pre-emergence blighting occurred in general at the lower temperatures. *Helminthosporium oryzae* was most active at the lower temperatures, whereas *Fusarium* spp. were most active at the higher temperatures.

The results of experiments on the effect of seed treatments on emergence, severity of seedling blighting, and yield of rice were inconsistent. Supreme Blue Rose seed from the Rice Branch Experiment Station responded favorably at certain dates to formaldehyde, ethyl mercury phosphate, ethyl mercury chloride, and red copper oxide dust treatments, as indicated by small increases in yields; Supreme Blue Rose seed from Beaumont, Texas, and Fortuna and Caloro seed from the Rice Branch Experiment Station and Beaumont failed to respond to similar treatments. Seedling emergence was increased and severity of blighting was reduced in some instances; however, the yields were not always increased accordingly. Consequently, seed treatments cannot be recommended for the control of rice seedling blight in Arkansas until more positive data are available.

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